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DAY AND NIGHT RETURNS INTERNATIONALLY

Studying the strength of the Capital Asset Pricing Model (CAPM) on open-to-close and close-to-open returns in international markets.

Bachelor's Thesis
Tatu Santikko
Aalto University School of Business
Department of Finance
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Author Tatu Santikko

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Abstract

This thesis provides additional evidence for the existence of an overnight effect on daily stock returns. Open-to-close and close-to-open returns are studied in markets that have had little research done so far in literature. The study was done using data from exchange traded funds from the studied markets, with data from years between 2002 and 2021. Consistent with existing literature, such as Hendershott et al. (2020), the market betas of close-to-open returns are a better explainer of returns than betas of open-to-close returns, although the results are not as robust as in said study. A review of possible reasons the existence of this effect, as well as a possible investment strategy benefitting from this discrepancy, is done.

Keywords Day-Night, Overnight Returns, Day Trading, Risk Premium, Market Efficiency

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1. Introduction

The capital asset pricing model (CAPM) implies that the higher an assets systematic risk is, the higher its expected returns are. The risk of an asset is represented by its market beta, and an assets risk premium is its market beta times the markets risk premium. However, most empirical studies have found that market beta is not enough to explain stock returns. On the other hand, beta has been found to be a good predictor in specific times and conditions. In this thesis, I study one of those times, the period between the market closing and it opening the next day. The strength of the effect can be seen in figure 1 below.

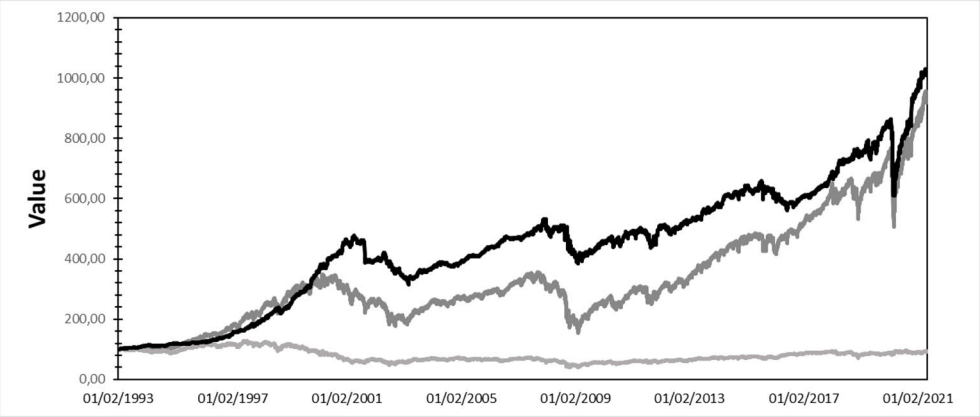

Figure 1: Cumulative returns of SPY 1993-2021. Close-to-open returns in black on top, normal daily returns in gray, and on the bottom, open-to-close returns in light gray. The strong correlation of close-to-open returns and the daily returns can be seen, as well as the low correlation of open-to-close returns. The outperformance of close-to-open returns can also be seen.

The stock market is not open 24 hours a day, seven days a week. It is usually open from the morning until the afternoon, exact times depending on the exchange. This is for historical and practical reasons. In the past, before electronic trading, each trade had to be cleared after the trading day. Some markets are open around the clock, such as forex markets and crypto currency markets, but there has been no significant push for stock markets to be open through the night. Perhaps stock traders do not want their profession to become a 24-hour job, more than it already is.

Most reported daily stock price returns are based on a 24-hour return, usually from market close to market close. Open to open returns have also been studied, and have been found to be more volatile (Stoll and Whaley, 1990). In this thesis I am interested in research done about whether returns come from

when the market is open, or when it is closed, such as Kelly and Clark in 2011 and other research which I will present later. This is done by comparing returns during market hours (From market open until market close, OC), and returns during non-market hours (From market close until market open, CO).

Comparing OC and CO returns shows, that markets tend to open higher than they closed the day before. This means that stock market returns during the day tend to be negative, and returns during the night tent to be positive. Studying the returns more closely shows, that it is correlation to the market, or CAPM beta, that is respectively negative and positive. One would expect the capital asset pricing model to properly explain risk premiums all the time, not just during the night. But indeed, the relation between returns and beta are weaker than expected, except during specific times, such as in this case, non-market hours. (Hendershott et al, 2020)

Most studies done on asset pricing during the day and night are focused on the US, and study international markets only to confirm that the effect is not US specific. In addition, the international markets are usually studied as a whole. For example, Hendershott et al. group the international markets into two baskets, Europe and Asia, and study them as two wholes instead of individual markets.

This thesis provides an analysis of day and night returns for specific countries and their stock markets using exchange traded funds (ETFs). The sample includes 16 countries and 17 ETFs covering thousands of stocks. Using ETFs simplify the data gathering and manipulation immensely, but in turn there are some issues to consider, which I will go over in the data section of the thesis. I study the returns and market betas, and whether the CAPM beta is a predictor of returns from market close to market open. In addition, I will study the difference in the strength of the effect in different countries and their stock markets.

This thesis is structured like follows: in the next section, section 2, I will go over the existing literature on asset returns during market hours and non-market hours. In addition, I will state my hypotheses for my own research based on theory and the aforementioned literature. In the third section I will

present and detail the dataset used, and the sources used. The fourth section will be for the methodology and analyses used to study the dataset. In the fifth section I will present and discuss the results from the analyses performed. And lastly, the sixth section will be the conclusion, where I will also offer some additional topics to study.

2. Literature review and hypotheses

The main studies used as a basis for this thesis are “Asset pricing: A tale of night and day” (Hendershott et al., 2020), and “Returns in trading versus non-trading hours: The difference is day and night” (Kelly & Clark, 2011). They both address the fact, that even though one would expect returns to be spread evenly through the day as market efficiency would imply, they are not. They find evidence for this day and night effect, focusing on US markets, and confirming the effects existence on international markets as well. However, they treat the international markets as a whole, and research it only as a comparison to their main research of the US market. Some research has been done on the effect on other markets, usually focusing on certain geographies, such as China (Ma et al., 2021), or on the options markets (Muravyev & Ni, 2016).

Studies have been done also on whether factor models perform better with overnight returns. Kleespie (2020) studies factor models like the Fama-French (1996) and the Fama-French (2015), and finds that CO returns perform better in explaining a portfolios performance, but OC returns perform better in explaining a portfolios variance. He finds that OC returns are based more on investor sentiment, while CO returns are based more on the state of macroeconomics.

Previously mentioned Ma et al. (2021) argue that the low amount of day trading on the Chinese markets is the reason that OC returns are in fact higher than CO returns, opposite to most other markets studied. Day trading is offered as a possible reason for lower OC returns by Kelly & Clark (2011), and Hendershott et al. (2020) as well. Hong and Wang (2007) offer another possible and simple explanation. As markets are closed, investors cannot observe market prices, and cannot exit out of their positions if negative

information comes to light. This means that periods of market closure are risky for investors, and as such, must offer a higher premium.

As it is almost certain that this effect exists, this thesis does not focus on reconfirming its existence on already studied markets. Instead, I will confirm its existence in other, as of yet unstudied or understudied, markets where possible, using US markets as a baseline and a comparison.

Assuming that the markets studied are as efficient as the US market, and that the studied exchange traded funds track their underlying indices accurately, my hypotheses are the following:

For all the studied markets, the OC CAPM beta is significantly close to zero, and the CO CAPM beta is significantly positive,

and:

For all the studied markets, the OC CAPM beta has a low or negative correlation coefficient to daily OC returns, and the CO CAPM beta has a positive and significant correlation coefficient to daily CO returns.

3. Data

The data needed for this thesis is relatively simple and easy to get. As it focuses on Open-to-Close and Close-to-Open returns, any asset with opening and closing prices available could be studied. This study focuses on ETFs tracking main indexes of different countries, comparable to SPY for USAs S&P500. As such, the data consists of publicly traded ETFs listed in different stock markets, tracking the main stock indexes of their respective countries.

To be useful, the ETFs must have a high enough volume and a low enough tracking error that the results are sensible. The ETFs were filtered first by daily volume, which had to be at least 50 000$ on average. Some additional filtering had to be done afterwards, when it was clear from investigation that the data was not suitable for research. As such, some ETFs tracking indexes from smaller countries, such as Finland, had to be left out. In addition, ETFs must have both opening prices and closing prices. Some ETFs in the data set did not include separate opening and closing prices until some date, and these

ETFs are included in the study only after that date. In countries with multiple ETFs tracking the main index, the ETF with the highest volume and longest history was chosen. Issues such as tracking error could be worked around by constructing index portfolios by hand from stock level data. However, for this thesis, ETFs are good enough. Both methods have been used in the literature, ETFs (Kelly & Clark, 2011), and constructed portfolios (Hendershott et al., 2020).

To use the CAPM, I need risk-free and market returns. As risk-free returns I use a data set of US 3-month treasuries from 2002 to 2021. The data is collected from the St Louis Feds FRED. As market returns, I use the ETF SPYs returns from 2002 to 2021. It tracks the main index, S&P500, of the United States market.

The full list of studied ETFs and the indexes they track can be found in table 1. The data set covers 16 markets from 2002 to 2021.

4. Methodology

The OC return on date t is simply:

$$R_t^{OC} = (Close_t - Open_t)/Open_t$$

I replicate Hendershott et al. (2020) in constructing the CO return on date t:

$$R_t^{CO} = \frac{1+R_t^{CC}}{1+R_t^{OC}} - 1 ,$$

where R_t^{CC} is the simple Close-to-Close return of date t, provided in data, and R_t^{OC} is calculated above. These OC and CO returns are calculated for all ETFs in the dataset, as they are used in the OLS regressions. All returns are calculated in the local currency. CO returns are for a longer period of time every day compared to the OC returns, as the stock market is closed for 16 to 18 hours, and open for only 6 to 8 hours. In addition, CO returns include longer periods where the stock market is closed, such as weekends and holidays.

As this thesis is interested in the CAPM beta of OC and CO returns, I use an OLS regression to compute coefficients for both OC and CO daily returns separately, again similarly to Hendershott et al. (2020):

$$R_{i,t}^{CO/OC} - R_{f,t} = \alpha_{i,t}^{CO/OC} + \beta_{i,t}^{CO/OC}(R_m - R_f) + \varepsilon_{i,t}^{CO/OC} ,$$

where $\alpha_{i,t}^{CO/OC}$ is the intercept for OC or CO returns, $\beta_{i,t}^{CO/OC}$ is the CAPM beta for OC or CO returns, $R_{m,t}$ is the market return, and $\varepsilon_{i,t}^{CO/OC}$ is the error term for OC or CO returns, and R_f is the risk-free interest rate, adjusted to daily interest. Risk free rate is only used for CO returns, as OC returns are already equal to the risk premium because the trades are settled on the same day (Kelly & Clark, 2011)

In addition to the OC and CO betas for the different ETFs, I will study the predictable power of these OC and CO betas on OC and CO returns. This is done with an OLS regression, using the previous regressions betas as predictors:

$R_i^{OC/CO} = C_0 + C_1\beta_i^{CO/OC} + \varepsilon_i^{CO/OC}$, where C_0 is the intercept, C_1 is the correlation coefficient for the beta of OC or CO returns on daily OC and CO returns, and $\varepsilon_i^{CO/OC}$ is the error term.

5. Results

When looking at the results, one has to remember that the period of time where CO returns occur is longer than the period of time for OC returns, as markets are open for 6 to 8 hours a day only. In addition, CO returns include returns over weekends and holidays as well.

The results of the OLS regression for all 15 ETFs can be seen in table 2. As expected, the effect is present and significant in all studied ETFs. The CAPM betas of OC returns are consistently low and close to zero, while the betas of CO returns are consistently and very significantly positive, ~0,6 on average. The R^2 of CO returns are also consistently higher than those of OC returns. The results are in accordance with my first hypothesis.

The average daily OC and CO returns can be seen in table 3. They are what one would expect. All CO returns are positive, and all but one OC return are negative. The ETF tracking the Hong Kong market is the only one with positive OC returns, which is consistent with studies on the Chinese market, which had positive OC returns, unlike most other markets. (Ma et al., 2021)

In table 4, one can see the results of the secondary OLS regression on the OC and CO CAPM betas and daily OC and CO returns shown before. As one would expect, the coefficient for OC returns is negative, and the coefficient for CO returns is positive. However, the results are less significant than in literature, but this is most likely the result of a lower sample size, and possible daily tracking error on ETFs that were not filtered by a low enough volume. As such, I am confident that even with these possible issues, the results are consistent with my second hypothesis, and I believe I have shown the effects existence in the studied markets and the ETFs that track them.

The results indicate that holding stocks outside of trading hours, such as these studied ETFs, offers superior returns, as well as stronger correlation to the broader market. In fact, holding stocks only during the day would offer returns close to zero, or even negative. These findings are consistent with existing literature. Because of this, a long-short strategy could be possible. As discussed by Kelly & Clark (2011), the strategy would be buying shares of an ETF at market close, selling it at the next market open, shorting a share of the same ETF right away, then buying back the share at close. This would be repeated daily, and in theory would offer superior returns to a simple buy and hold strategy. However, transaction costs would lower the returns. Even if an investor could not follow such a strategy, one could take advantage of the effect by timing the transactions one would make anyway.

The literature offers different reasons for the existence of the effect. The evidence from the Chinese market (Ma et al., 2021) is strong evidence that day trading, closing positions the same day they were opened, could be one of the reasons for superior CO risk premiums. Another reason could be the inherent risk of holding stocks through a period where new information can come to light, but an investor cannot exit their position (Hong and Wang, 2007).

The difference in investors reactions to new announcements, specifically earnings announcements, during the trading day and after close could be another reason (Francis et al., 1992). Indeed, information moves 24 hours a day, but stock prices do not. In informationally efficient markets price changes are linked to new information. This means that during the period of market closure, either buying or selling pressure would accumulate until markets open, which would explain some of the overnight returns. As aftermarket announcements were found to be positive on average, overnight returns would also be positive on average. (Cooper et al., 2008)

6. Conclusion

In this thesis I analyzed the difference in open-to-close and close-to-open returns in different international markets using data from exchange traded funds. Additionally, I calculated market betas for these ETFs, for both OC and CO returns. I studied the effectiveness of these betas as predictors for daily OC and CO returns. The sample consisted of 15 ETFs from 15 countries from Europe, Asia and Latin America, as well as 2 ETFs from the United States as a baseline comparison and the market return.

First, I calculated market betas for the different ETFs OC and CO returns using an OLS regression. Then, I calculated the average daily OC and CO returns for all the studied ETFs. Finally, using the betas from the first regression, I studied how these betas worked as predictors for OC and CO returns.

My findings are consistent with the literature discussed in this thesis. I showed that the CO returns are more correlated to the overall market, and that OC returns are weakly or not correlated to the overall market. The specific values of the coefficients on the second regression were not exactly comparable to Hendershott et al. (2020), and not as statistically significant. However, the difference, while noticeable, does not take away the fact that the results overall are consistent.

I add to the findings of others by studying markets where the strength and size of the difference in OC and CO returns were not yet studied. I confirmed the effects existence in these markets as well.

The results of this study and other similar studies have some implications to the investing public. An investment strategy offering abnormal returns would in theory be possible, as discussed before. Additionally, the act of day trading seems even less wise than before in light of the fact that market returns are flat during the day. Day trading could in fact be one of the reasons for the existence of this difference in returns.

Additional research could be done studying overnight returns in smaller markets using constructed portfolios. Another interesting point of research could be to quantify the effect of tracking error of ETFs on overnight returns.

Table 1

Ticker	Index	Country	Exchange	Years
SPY	S&P500	USA	NYSE	1993-2021
QQQ	Nasdaq 100	USA	Nasdaq	2002-2021
IOZ	S&P/ASX200	Australia	Sydney	2011-2021
EX01	ATX	Austria	Vienna	2015-2021
BOVA11	Ibovespa	Brazil	B3	2008-2021
XIU	S&P/TSX60	Canada	Toronto	2002-2021
DKIDKIX	OMXCPHGI	Denmark	Copenhagen	2002-2021
CAC	CAC40	France	Paris	2002-2021
GDAXIEX	DAX	Germany	Xetra	2002-2021
2800	Hang Seng	Hong Kong	Hong Kong	2014-2021
ETFMIB	FTSE MIB	Italy	Borsa Italiana	2003-2021
1330	Nikkei 225	Japan	Tokyo	2002-2021
IAEX	AEX	The Netherlands	Amsterdam	2005-2021
069500	KOSPI200	South Korea	Seoul	2013-2021
XACTOMXS30	OMXS30	Sweden	Stockholm	2002-2021
ISF	FTSE100	The UK	London	2002-2021

Table 2

Ticker	Returns over	Intercept	Beta	Adjusted R^2
QQQ	OC	0,003526	0,286584	0,209556
		(19,75924)	(35,87271)	
	CO	-0,003	0,738502	0,713394
		(-19,9821)	(109,9187)	
IOZ	OC	-0,0003	0,118303	0,034807
		(-1,73531)	(9,4532)	
	CO	-0,00249	0,427666	0,233216
		(-11,4739)	(27,45323)	
EX01	OC	0,000376	0,180057	0,045669
		(0,713847)	(6,721202)	
	CO	-0,00357	0,534091	0,209072
		(-5,37082)	(15,79664)	
BOVA11	OC	0,001045	0,32016	0,106113
		(4,421155)	(19,1244)	
	CO	-0,00145	0,602657	0,39653
		(-7,64857)	(44,99411)	
XIU	OC	0,00192	0,172048	0,134066
		(13,63249)	(27,25784)	
	CO	-0,00342	0,70491	0,673373
		(-21,6124)	(99,46657)	
DKIDKKIX	OC	0,000429	0,061452	0,024501
		(3,430186)	(10,88341)	
	CO	-0,00346	0,685372	0,475518
		(-14,9153)	(65,38912)	
CAC	OC	0,002204	0,204803	0,120589
		(12,48423)	(25,81518)	
	CO	-0,00398	0,660935	0,55563
		(-21,1159)	(77,95408)	
GDAXIEX	OC	0,002381	0,216035	0,116307
		(12,48929)	(25,2287)	
	CO	-0,00378	0,670119	0,569746
		(-20,2968)	(80,02416)	
2800	OC	0,000948	0,118467	0,034292
		(3,994454)	(7,846929)	
	CO	-0,00458	0,424669	0,282737
		(-17,9481)	(26,14427)	

ETFMIB	OC	0,000974 (4,317621)	0,176852 (17,49691)	0,064435
	CO	-0,00278	0,69167	0,590045
		(-14,3926)	(79,98527)	
1330	OC	0,000701	0,081355	0,025434
		(4,339381)	(11,13162)	
	CO	-0,00444	0,595277	0,388753
		(-18,5268)	(54,95209)	
IAEX	OC	0,001545	0,180403	0,121319
		(9,053684)	(23,38571)	
	CO	-0,00322	0,674372	0,593327
		(-16,3994)	(76,01977)	
069500	OC	0,000771	0,152595	0,06334
		(4,223059)	(12,04931)	
	CO	-0,00373	0,387742	0,255415
		(-18,095)	(27,13826)	
XACTOMXS30	OC	0,00174	0,19261	0,092728
		(8,989966)	(22,12142)	
	CO	-0,00359	0,652948	0,507592
		(-17,3502)	(70,25416)	
ISF	OC	0,001623	0,160726	0,081575
		(9,102846)	(20,33803)	
	CO	-0,00402	0,655137	0,523123
		(-19,4342)	(71,47462)	

Table 3

Ticker	OC	CO
QQQ	-0,0070%	0,0562%
IOZ	-0,0924%	0,1170%
EX01	-0,166%	0,237%
BOVA11	-0,0307%	0,0856%
XIU	-0,0123%	0,0366%
DKIDKIX	-0,0362%	0,0505%
CAC	-0,0222%	0,0329%
GDAXIEX	-0,0199%	0,0437%
2800	0,0090%	0,0137%
ETFMIB	-0,1046%	0,1146%
1330	-0,0252%	0,0537%
IAEX	-0,0308%	0,0530%
069500	-0,0122%	0,0400%
XACTOMXS30	-0,0543%	0,0860%
ISF	-0,0425%	0,0513%

Table 4

Returns over	Intercept	Coefficient	R^2
OC	0,00052	-0,00048	0,00521
	(1,49599)	(-0,26085)	
CO	0,00111	0,0065	0,01815
	(1,35082)	(-0,49018)	

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